
ABSTRACT

The wide spread prevalence of lost limbs and sensing system is of major concern in present day due to wars, accident, age and health problems. This Omni-directional wheelchair was designed for the less able elderly to move more flexibly in narrow spaces, such as elevators or small aisle. The wheelchair is developed to help disabled patients by using speech recognition system to control the movement of wheelchair in different directions by using voice commands and also the simple movement of the patient's fingers with keypad control. From previous literature surveys it was observed that the moments of wheels of wheelchair is difficult in diagonals direction, in this proposed system achievement of wheelchair movement in all direction is obtained by using multi-directional Omni-wheels which makes the diagonal moments comparatively flexible.

KEYWORDS: Omni-wheels; Obstacles detection; Ultrasonic sensor; Voice recognition; Wheelchair; AVR Programmable Microcontroller.

INTRODUCTION

There are patients who are handicaps or paralyse in some accident, wars or by birth, as a result of higher level spinal cord injury or brain and nervous system disorder. These kinds of patients can't use the standard or an ordinary wheelchair which depends on the arms muscular force to move the wheelchair. So these types of patients still need the help of some other person to move their wheelchair from one place to another. Many researchers have proposed different and unique methods to control the wheelchair like using joystick but it is not suitable for patients those are not having hands. So one of the possible solutions for them is to use their wheelchair using voice control. Voice recognition technology depends on converting a particular spoken word to an electrical signal which is further digitized in order to be processed by a microcontroller or computer.

Mohammed Faeik Ruzaij (2012) proposed an Implementation of Low Cost Intelligent Wheelchair but it is costly due to using of HM2007 module for voice recognition and digitalization [3].

Aruna.C (2014) proposed wheelchair using voice recognition and touch screen control which include HM2007 module which is pre-programmed to store 40 spoken commands as a command template and touch screen to control wheel chair [1]

Shraddha Uddhav khadilkar (2015) implemented Android phone controlled Voice, Gesture and Touch screen operated Smart Wheelchair used android app for voice recognition and ordinary wheels with two DC motors. [5]

M.BALA KUMARAN (2013) implemented Implementation of Voice Based Wheelchair For Differently Abled used PIC microcontroller, VRbot module, stepper motor and ultrasonic sensor for movements of wheelchair. [6]

Chandan Banerjee (2010) proposed Low Cost Speech and Vision Based Wheel Chair For Physically Challenged which include DSP processor which enable speech and image processing [4].

M.Senthil Sivakumar (2013) proposed SPEECH CONTROLLED AUTOMATIC WHEELCHAIR which comprises of a wheelchair, voice module and navigation module. In this The wheelchair can automatically navigate from one point to other in the home as per command from the voice module.[2]

MATERIALS AND METHODS

METHODOLOGY:

The block diagram shown in Fig.1 includes all the wheelchair elements, starting with the microphone (android phone) which is used to pick up the voice command (sound wave) from the user and transmit it to the bluetooth module. The next unit is the bluetooth module which receives the output of the android app, digitizes it and stores the result signal as template which indicates the users command. The next block is the microcontroller circuit which receives the control signal from the bluetooth module and also from the obstacle detection circuit, which includes two ultrasonic sensors. The microcontroller output is connected to the motor driver circuit which includes the relays used to control the DC motor's direction of rotation giving the wheelchair movement in four directions (Omni wheels). The charger is used to charge the 12-volt battery, which is the main source of power for the wheelchair.

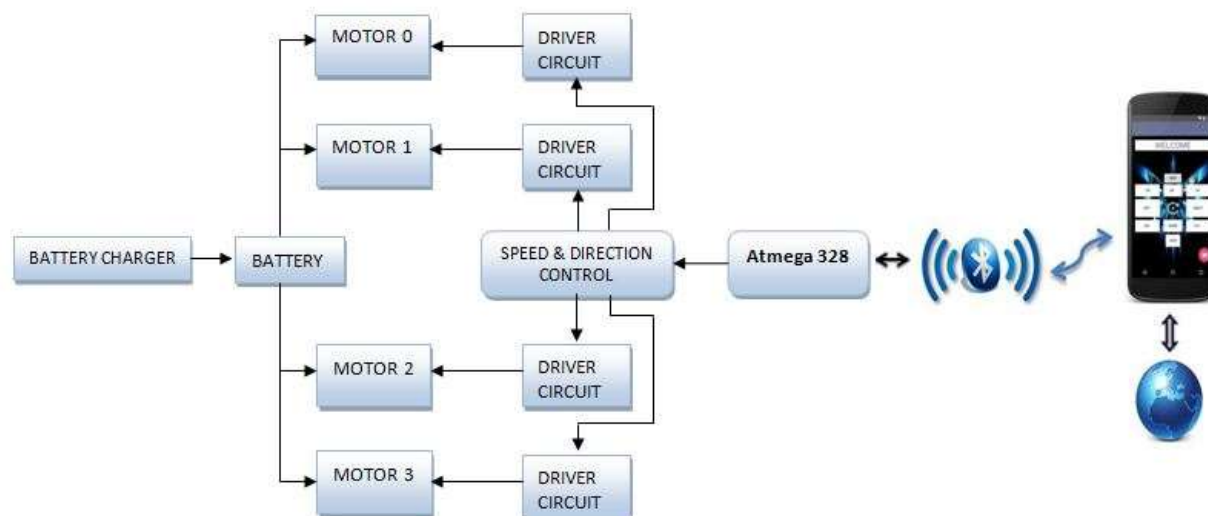


Figure 1: Block Diagram of Wheelchair

A. Microcontroller Unit:

The microcontroller unit is the core of the intelligent wheelchair. It interfaces the voice recognition unit and the motor driver circuit. The main function of this unit is to receive the data from the HC05 Bluetooth module through serial communication and determine the right command to be given to the driver circuit. The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port.

B. DC Geared Motor:

The wheelchair moves by four DC motors. Each one can be started with a maximum of 25kg weight. So the total weight that can be held by these four motors is 100 kg including the wheelchair component. The operating voltage and current are 12 Volts and 7 Amps respectively.

C. Motor Driver:

Motor speed control interface via UART, I2C, PPM signal and analog input and can be controlled in both directions down to almost 1% of maximum speed. The I2C master device can control multiple RMCS-210x via simple I2C command structures and an RC receiver or any PPM source can directly control the speed of the motor. An analog signal or fixed analog voltage from a potentiometer can directly control, speed of the motor.

D. Omni-Wheels:

A wheelchair that uses Omni-wheels can move in any direction as shown in figure, at any angle, without rotating beforehand. If you want a wheelchair that can straff, use an Omni-wheel wheelchair. If you want a wheelchair that can spin while translating forward at the same heading, then you want this type of wheelchair.

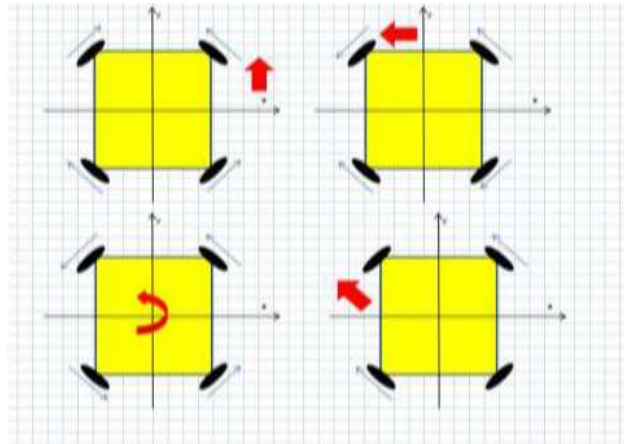


Fig 5: Working of Omni-wheels

Control Algorithm:

To control the wheelchair by voice command, a user inputs voice command and verification command to prevent wrong action by the misrecognition. In our system, the control algorithm is shown in figure 2 and detail is as follows:

1. User inputs a reaction command.
2. Input voice data is recognized and its result word is displayed.
3. When result word is a stop command, go to 7.
4. User inputs a verification command. When any verification command is not input within three seconds, the system considers that recognition result fails and go to 1.
5. Input verification voice data is recognized.
6. When result word is a rejection command, go to 1.
7. Control system sends the target control signal to the wheelchair, and the wheelchair reacts. Go to 1.

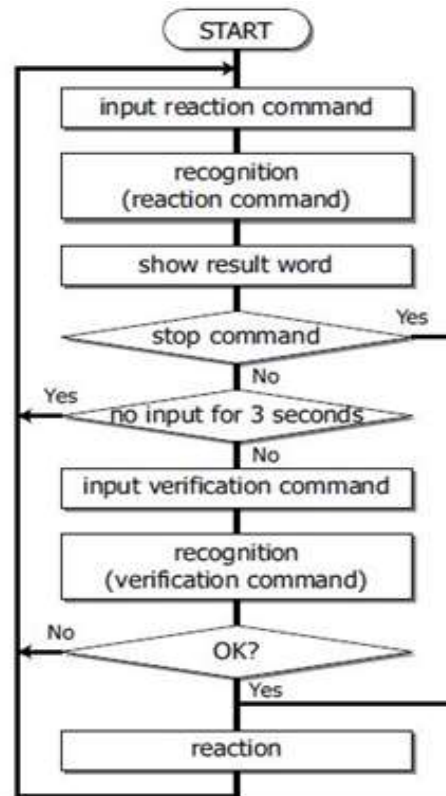


Fig4: Control Algorithm

RESULTS AND DISCUSSION

Fig 5 shows the construction of the base of the wheelchair in which the motors are placed at 45° from the axis and Omni wheels are connected to the motor as shown in the fig. With the help of Omni-wheels the wheel chair can Move in all the 8 direction more easily as compared to the previously used wheelchair.

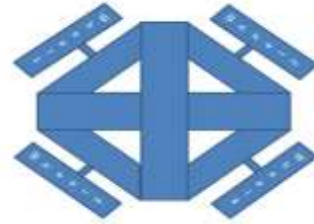


Fig. 5: Wheelchair construction

This mobile app is totally based on android system. *Android* is an operating system based on the Linux kernel. The project responsible for developing the Android system is called the *Android Open Source Project* (AOSP) and is primarily lead by Google.

Features of Android :

- Open source
- Media Support
- Huge memory
- Fast processor
- Built in I/O devices
- Native support for more sensors
- Improved battery efficiency
- Multitasking
- Have open source software development



Fig 6: Android app for the operation of Wheelchair.

Formulae:

Torque required by each DC motor

$$T = \left(\frac{100}{e}\right) * \frac{(a + g * \sin \theta) * M * R}{N} \quad (1)$$

Total Power required

$$P = T * w \quad (2)$$

Current required

$$I = \frac{T * w}{V} \quad (3)$$

Capacity of battery

$$c = I * t \quad (4)$$

Table1 : Orientation of motors for different commands

Directions	Motor 1	Motor 2	Motor 3	Motor 4
Forward	Clockwise	Anticlockwise	Clockwise	Anticlockwise
Backward	Anticlockwise	Clockwise	Anticlockwise	Clockwise
Right	Clockwise	Clockwise	Anticlockwise	Anticlockwise
Left	Anticlockwise	Anticlockwise	Clockwise	Clockwise
Degree45	Clockwise	Off	off	Anticlockwise
Degree135	off	Anticlockwise	Clockwise	off
Degree225	Anticlockwise	off	off	Clockwise
Degree315	off	Clockwise	Anticlockwise	off
fast	Clockwise	Anticlockwise	Clockwise	Anticlockwise
Rotate	Clockwise	Clockwise	Clockwise	Clockwise
Stop	off	off	off	off

CONCLUSION

All the modules of the proposed speech controlled wheelchair are constructed to implement a Wheel Chair using Voice Recognition. Microcontroller: Atmega 328 is programmed to use wheelchair in all direction, aided by the Omni wheels. The voice recognition circuit (Android mobile) identifies the voice direction to move the chair in the specified direction or to stop. Ultrasonic detector module detects the intruder that may appear in the path and stops the wheelchair in the response of identifying the intruder. The proposed wheelchair functions as a load carrying robot that is very useful for aged and physically challenged persons.

ACKNOWLEDGEMENTS

I am thankful to the principal Dr Vivek . K . Yakkundi, the PG Co-ordinator, Prof. Vandana khobragade and My project guide Prof. Vikas Kshirsagar for their support.

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